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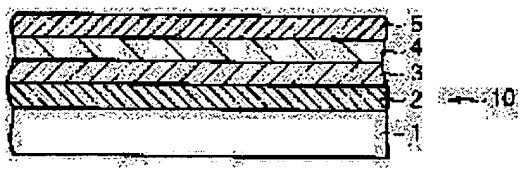
(54) PERPENDICULAR MAGNETIC RECORDING MEDIUM

(57)Abstract:

PROBLEM TO BE SOLVED: To improve the perpendicular orientation of a Co-base magnetic layer and to obtain a magnetic recording medium having a high coercive force and high reproduction output.

SOLUTION: The perpendicular magnetic recording medium has at least an underlayer and a Co-base magnetic layer. The underlayer comprises a laminate of at least two layers selected from combinations of i) Fe/Ru/a magnetic layer, Cr/Ru/a magnetic layer or an alloy of Fe and Ta, C, Zr, N or Co/Ru/a magnetic layer, ii) a Co-containing layer/Ru/a magnetic layer and iii) Ru/a Co-containing layer/a magnetic layer.



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CLAIMS

[Claim(s)]
[Claim 1] From the iron formed on the nonmagnetic substrate and this nonmagnetic substrate, become substantial or iron is made into a principal component. The 1st ground layer which contains at least one sort of elements chosen from the group which consists of a tantalum, carbon, a zirconium, nitrogen, and cobalt as an accessory constituent, this -- the 2nd ground layer which contains the ruthenium prepared on the 1st ground layer as a principal component -- and -- this -- the vertical-magnetic-recording medium characterized by providing the magnetic layer containing the cobalt formed on the 2nd ground layer
[Claim 2] The ground layer of the above 1st is a vertical-magnetic-recording medium according to claim 1 characterized by including a tantalum and carbon as an accessory constituent.
[Claim 3] The ground layer of the above 1st is a vertical-magnetic-recording medium according to claim 1 characterized by including a zirconium and nitrogen as an accessory constituent.
[Claim 4] The ground layer of the above 1st is a vertical-magnetic-recording medium according to claim 1 characterized by including cobalt as an accessory constituent.
[Claim 5] the 1st ground layer which contains the cobalt formed on the nonmagnetic substrate and this nonmagnetic substrate as a principal component -- this -- the 2nd ground layer which contains the ruthenium prepared on the 1st ground layer as a principal component -- and -- this -- the vertical-magnetic-recording medium characterized by providing the magnetic layer containing the cobalt formed on the 2nd ground layer
[Claim 6] The ground layer of the above 1st is a vertical-magnetic-recording medium according to claim 5 which contains at least one sort of elements among the groups which consist of a zirconium, niobium, and chromium as an accessory constituent.
[Claim 7] The ground layer of the above 1st is a vertical-magnetic-recording medium according to claim 6 characterized by including a zirconium and niobium as an accessory constituent.
[Claim 8] The ground layer of the above 1st is a vertical-magnetic-recording medium according to claim 6 characterized by including chromium as an accessory constituent.
[Claim 9] The ground layer of the above 1st is a vertical-magnetic-recording medium according to claim 8 characterized by not showing ferromagnetism.
[Claim 10] the 1st ground layer which becomes substantial from the chromium formed on the nonmagnetic substrate and this nonmagnetic substrate -- this -- the 2nd ground layer which contains the ruthenium prepared on the 1st ground layer as a principal component -- and -- this -- the vertical-magnetic-recording medium characterized by providing the magnetic layer containing the cobalt formed on the 2nd ground layer
[Claim 11] The ground layer of the above 2nd is a vertical-magnetic-recording medium given in the claim 1 or any 1 term of 8 which consists of a ruthenium substantially.
[Claim 12] the 1st ground layer which contains the ruthenium formed on the nonmagnetic substrate and this nonmagnetic substrate as a principal component -- this -- the 2nd ground layer which contains the cobalt prepared on the 1st ground layer as a principal component -- and -- this -- the vertical-magnetic-recording medium characterized by providing the magnetic layer containing the cobalt formed on the 2nd ground layer
[Claim 13] The ground layer of the above 2nd is a vertical-magnetic-recording medium according to claim 12 characterized by including chromium as an accessory constituent.
[Claim 14] The ground layer of the above 2nd is a vertical-magnetic-recording medium according to claim 13 characterized by not showing ferromagnetism.
[Claim 15] The ground layer of the above 1st is a vertical-magnetic-recording medium given in the claim 11 or any 1 term of 14 which consists of a ruthenium substantially.
[Claim 16] The aforementioned magnetic layer is a vertical-magnetic-recording medium given in the claim 1

characterized by including platinum and oxygen further, or any 1 term of 15.
[Claim 17] The aforementioned magnetic layer is a vertical-magnetic-recording medium given in the claim 1 characterized by having the multilayer structure which carried out the laminating of cobalt, platinum and the ferromagnetic layer that makes oxygen a principal component, and the non-magnetic layer which consists of an alloy which makes a ruthenium a principal component by turns, or any 1 term of 16. [Claim 18] The aforementioned non-magnetic layer is a vertical-magnetic-recording medium according to claim 17 which becomes substantial from a ruthenium.
[Claim 19] A vertical-magnetic-recording medium given in the claim 1 characterized by preparing a soft-magnetism layer further between the aforementioned nonmagnetic substrate and the ground layer of the above 1st, or any 1 term of 18.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention is concerned with a vertical-magnetic-recording medium, and relates to the vertical-magnetic-recording medium which has a ferromagnetic magnetic-recording layer containing especially cobalt.
[0002]
[Description of the Prior Art] Conventionally, by the magnetic-recording medium which used the cobalt (Co) system alloy for the magnetic layer, although the method of dividing the magnetic interaction between magnetic particles by adding chromium (Cr) and carrying out the segregation of the Cr to the grain boundary was used in order to raise the holding power and S/N ratio, there was a trouble that a crystal magnetic anisotropy fell, by such method.
[0003] On the other hand, by the magnetic-recording medium which used Co and the platinum (Pt) system alloy for the magnetic layer, though it had the outstanding feature it is featureless in other elements of having a bigger crystal magnetic anisotropy than the case where Co system alloy is used, there was a trouble that Pt did not carry out a segregation to a grain boundary.
[0004] on the other hand, it is indicated by recent years, for example, JP,7-235034,A, and U.S. JP,5,792,564,B -- as -- a CoPt system magnetic layer -- oxygen -- adding -- oxygen -- the method of dividing the magnetic interaction between CoPt magnetic particles was devised by forming the rich grain boundary, and it became possible to create the record medium having the big holding power which utilized the big perpendicular anisotropy, and a good S/N ratio
[0005] However, the CoCr system alloy also used as the mainstream of the magnetic layer in the present magnetic-recording medium within a field About the ground layer which raises the property to a late-coming CoPtO system magnetic layer to the optimal ground layer being investigated enough as for the orientation within a field, and perpendicular orientation Although research of V ground layer etc. is done about the orientation within a field, the present condition is seldom investigated about perpendicular orientation. As a ground layer from which good perpendicular orientation is acquired, the material of a titanium (Ti) system is well known to the CoCr system alloy layer, in addition the effective thing is known also to the CoPt system alloy layer including the zirconium (Zr), the ruthenium (Ru), the hafnium (Hf), etc. However, when actually used as a ground layer of the CoPtO system magnetic layer which oxidized the CoPt alloy, the perpendicular orientation at the time of using Ti and TiCr as a ground layer was clearly inadequate, and some ways at the time of using a ruthenium as a ground layer were the grades which can be referred to as good. Furthermore, when an iron (Fe) system alloy like TiN which takes NaCl structure similar in crystal, the same Cr of a body center cubic as vanadium (V), or a Sendust was also tried on the nitride of Ti, all had the strong orientation within a field and perpendicular orientation was inadequate.
[0006] Thus, in a CoPtO system magnetic layer, in order to improve the perpendicular orientation, even if it used the ground layer used for the magnetic layer besides the former, the expectable effect was not acquired.
[0007]
[Problem(s) to be Solved by the Invention] this invention was made in view of the above-mentioned situation, and aims at offering the magnetic-recording medium which has high coercive force and a high reproduction output by improving the perpendicular orientation of Co system magnetic layer.
[0008]
[Means for Solving the Problem] this invention becomes substantial from the iron or chromium formed on the nonmagnetic substrate and this nonmagnetic substrate the 1st. Or the 1st ground layer which contains at least one sort of elements chosen from the group which makes iron a principal component and consists of a tantalum, carbon, a zirconium, nitrogen, and cobalt as an accessory constituent, this -- the 2nd ground layer which contains the ruthenium prepared on the 1st ground layer as a principal component -- and -- this -- the magnetic-recording medium characterized

by providing the magnetic layer containing the cobalt formed on the 2nd ground layer is offered
[0009] the 1st ground layer which contains the cobalt with which this invention was formed on the nonmagnetic substrate and this nonmagnetic substrate the 2nd as a principal component -- this -- the 2nd ground layer which contains the ruthenium prepared on the 1st ground layer as a principal component -- and -- this -- the vertical-magnetic-recording medium characterized by providing the magnetic layer containing the cobalt formed on the 2nd ground layer is offered
[0010] the 1st ground layer which contains the ruthenium by which this invention was formed on the nonmagnetic substrate and this nonmagnetic substrate the 3rd as a principal component -- this -- the 2nd ground layer which contains the cobalt prepared on the 1st ground layer as a principal component -- and -- this -- the vertical-magnetic-recording medium characterized by providing the magnetic layer containing the cobalt formed on the 2nd ground layer is offered
[0011] the 1st ground layer to which this invention becomes substantial from the chromium formed on the nonmagnetic substrate and this nonmagnetic substrate the 4th -- this -- the 2nd ground layer which contains the ruthenium prepared on the 1st ground layer as a principal component -- and -- this -- the vertical-magnetic-recording medium characterized by providing the magnetic layer containing the cobalt formed on the 2nd ground layer is offered
[0012]
[Embodiments of the Invention] The magnetic-recording medium of this invention is a magnetic-recording medium which prepared the cobalt system alloy as a magnetic layer, and has a two-layer ground layer and a cobalt system alloy magnetic layer at least on a nonmagnetic substrate.
[0013] As for a cobalt system alloy magnetic layer, it is desirable that platinum and oxygen are included further.
[0014] The magnetic-recording medium of this invention is divided roughly into the following four invention by the combination of the 1st and 2nd ground layer.
[0015] The 1st ground layer makes iron a principal component, and the 2nd ground layer contains a ruthenium as a principal component in the 1st invention including at least one sort of elements chosen from the group which consists of a tantalum, carbon, a zirconium, nitrogen, and cobalt as an accessory constituent.
[0016] According to the 1st invention, the body center cubic system material included from iron or chromium as an accessory constituent which made iron the principal component and was chosen from a tantalum, carbon, a zirconium, nitrogen, and cobalt or it became substantial as 1st ground layer By using the ground layer of the laminated structure which furthermore formed the ruthenium of hexagonal system one by one as 2nd ground layer, the perpendicular stacking tendency and magnetic properties with Co system, especially a CoPtO system magnetic layer of a vertical-magnetic-recording medium are improvable. If especially this composition is used, since there will be an effect which can carry out [detailed]-izing of the 2nd ground layer and a record layer will also be made detailed by this, the changes noise of sulfuration can be reduced. In addition, as a record layer, not only Co alloy system but artificial grid systems, such as Co, Pt, and Co, Pd, and the thing by which oxygen is contained in these have the same effect.
[0017] As a desirable combination of a principal component and an accessory constituent, iron, a tantalum and carbon, iron, a zirconium and nitrogen, and iron and cobalt are mentioned.
[0018] Such desirable combination is soft-magnetism alloys which have high permeability, the vertical-magnetic-recording medium using this functions as the so-called perpendicular bilayer medium, and the effect which shows the record reproducing characteristics which were excellent with the interaction of a head and a soft-magnetism layer can be expected.
[0019] In the 1st ground layer, in the 2nd invention, the 2nd ground layer contains a ruthenium as a principal component including cobalt as a principal component.
[0020] The perpendicular stacking tendency and magnetic properties with Co system, especially a CoPtO system magnetic layer of a vertical-magnetic-recording medium are improvable by using the ground layer of the laminated structure which formed the hexagonal system or amorphous system material which contains cobalt as a principal component according to the 2nd invention as 1st ground layer, and formed the ruthenium of hexagonal system one by one as 2nd ground layer further. since there will be an effect as for which the 2nd ground stacking tendency is made more to fitness and it will become good [the orientation nearby of a record layer] by this, if this composition is used especially -- the noise of the saturation region of magnetization -- it can decrease -- record -- resolution can also improve In addition, as a record layer, not only Co alloy system but Co, artificial grid systems, such as Pt, Co, and Pd, and the thing by which oxygen is contained in these have the same effect.
[0021] As for the 1st ground layer, in the 2nd invention, it is desirable that at least one sort of elements are included among the groups which consist of a zirconium, niobium, and chromium as an accessory constituent. Moreover, cobalt, a zirconium and niobium, and cobalt and chromium are mentioned as a desirable combination of a principal component and an accessory constituent. As for the alloy containing cobalt and chromium, it is desirable that ferromagnetism is not shown. The combination of cobalt, a zirconium, and niobium is a soft-magnetism alloy which has high permeability, the vertical-magnetic-recording medium using this functions as the so-called perpendicular bilayer medium, and the effect

which shows the record reproducing characteristics which were excellent with the interaction of a head and a soft-magnetism layer can be expected.
[0022] In addition, in the 1st and 2nd invention, the 2nd ground layer has a substantially desirable bird clapper from a ruthenium.
[0023] In the 1st ground layer, in the 3rd invention, the 2nd ground layer contains cobalt as a principal component including a ruthenium as a principal component.
[0024] As for the 2nd ground layer, in the 3rd invention, it is desirable that chromium is included as an accessory constituent. As for the alloy of cobalt and chromium, at this time, it is desirable that ferromagnetism is not shown.
[0025] Moreover, the 1st ground layer has a ruthenium to a substantially desirable bird clapper.
[0026] According to the 3rd invention, the perpendicular stacking tendency and magnetic properties with Co system, especially a CoPtO system magnetic layer of a vertical-magnetic-recording medium are improvable by using the ground layer of the laminated structure which formed the 1st ground layer and the hexagonal system material which contains cobalt as principal components as 2nd ground layer further one by one for the material which contains the ruthenium of hexagonal system as a principal component. With this composition, the stacking tendency of a record layer and detailed-ization are made moderately, and both can reduce a changes noise and the noise of a saturation region. In addition, as a record layer, not only Co alloy system but Co, artificial grid systems, such as Pt, Co, and Pd, and the thing by which oxygen is contained in these have the same effect.
[0027] In the 1st ground layer, in the 4th invention, chromium and the 2nd ground layer contain cobalt.
[0028] An example of the structure of the magnetic-recording medium applied to this invention at drawing 1 is shown.
[0029] This magnetic-recording medium 10 has the structure which carried out the laminating of Co system ferromagnetism layers 4, such as the 1st ground layer 2 and the 2nd ground layer 3, for example, a CoPrO alloy etc., and the protective layer 5 to order on a substrate 1 so that it may illustrate.
[0030] Each class formed on the substrate can be formed by performing sputtering, for example by using those formation material as a target.
[0031] Moreover, let a magnetic layer be the multilayer structure which carried out the laminating of cobalt, platinum and the ferromagnetic layer that makes oxygen a principal component, and the non-magnetic layer which consists of an alloy which makes a ruthenium a principal component by turns in the above 1st or the 3rd invention.
[0032] The structure of other examples of the magnetic-recording medium applied to this invention at drawing 2 is shown.
[0033] Except that the layered product which has the non-magnetic layer 6 which consists of a ruthenium is formed between magnetic layer 4a and magnetic layer 4b instead of a magnetic layer 4, this magnetic-recording medium 20 has the same structure as drawing 1 , so that it may illustrate.
[0034] This non-magnetic layer becomes substantial from a ruthenium preferably.
[0035] Thus, the perpendicular orientation and perpendicular coercive force of this magnetic layer are further improvable by making the non-magnetic layer which makes a ruthenium a principal component for a magnetic layer as a nonmagnetic interlayer into the multilayer structure prepared in the ferromagnetic layer by turns.
[0036] Furthermore, in the above 1st or the 3rd invention, a soft-magnetism layer can be further prepared between a nonmagnetic substrate and the 1st ground layer.
[0037] The cross section which expresses an example of further others of the composition of the magnetic-recording medium of this invention to drawing 3 is shown.
[0038] This magnetic-recording medium 30 has the same composition as drawing 1 except the soft-magnetism layer 7 being formed between a substrate 1 and the 1st ground layer 2 so that it may illustrate.
[0039] By preparing such a soft-magnetism layer, the obtained magnetic-recording medium functions as a perpendicular bilayer film, and the effect which shows the record reproducing characteristics which were excellent with the interaction of a head and a soft-magnetism layer can be expected.
[0040] As such a soft-magnetism layer, a Sendust, a permalloy, a ferrite, FeGaGe, FeGeSi, FeAlGa, FeRuGaSi, FeSi, FeCoNi, FeSiB, FeNiPB, FeSiC, FeCuNbSiB, FeZrB, FeZrBCu, CoFeSiB, CoZrTa, CoTi, etc. are mentioned.
[0041] A cobalt system alloy magnetic layer with the perpendicular orientation which was excellent by forming on a substrate the 1st ground layer which consists of nonmagnetic [specific] or soft magnetic materials, the 2nd ground layer which consists of a specific non-magnetic material, and the layer which consists of a ferromagnetic material according to this invention is obtained, and, thereby, the magnetic-recording medium in which high coercive force and a high reproduction output are shown is obtained.
[0042]
[Example] Hereafter, an example is shown and this invention is explained concretely.
[0043] As an example 1 nonmagnetic substrate, the glass substrate which fills the standard specifications of a 2.5 inch

magnetic disk was prepared.
[0044] Following each class was formed on this glass plate. In addition, DC magnetron sputtering performed all production of each class.
[0045] First, Cr layer with a thickness of about 40nm was formed as the 1st ground layer.
[0046] Next, the ruthenium layer with a thickness of about 37nm was formed as the 2nd ground layer on Cr layer.
[0047] On the obtained 2nd ground layer, sputtering of a CoPtCr alloy target was performed in Ar atmosphere containing O2 of a minute amount, and the CoPtCrO magnetic layer was formed. In addition, composition of a CoPtCr alloy target was set to Co-20at%Pt-16at%Cr here. In this case, although what has comparatively high Cr concentration is used, if Cr is less than [16at%], there will almost be no change of the structure of the essential magnetic layer accompanying addition of Cr, and the effect same also as a property of a medium will be acquired.
[0048] Then, the laminating of 10nm the C was carried out as a protective layer, and the magnetic-recording medium was obtained.
[0049] About the obtained magnetic-recording medium, the magnetic properties by the oscillating sample type magnetometer (VSM) were measured. The result is shown in Table 1.
[0050] Here, Hc** and Hc// are the coercive force at the time of impressing a magnetic field to a film surface perpendicular and film surface inboard, respectively, and a perpendicular square shape ratio shows the ratio of the residual magnetization to the saturation magnetization at the time of impressing a magnetic field perpendicularly.
[0051] As the example 2 1st ground layer, the magnetic-recording medium was obtained like the example 1 except having formed Fe layer with a thickness of about 50nm instead of Cr layer. In addition, Fe layer used here was formed by carrying out the spatter of the Fe target in argon atmosphere. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0052] As the example 3 1st ground layer, the magnetic-recording medium was obtained like the example 1 except having formed the FeTaC layer with a thickness of about 100nm instead of Cr layer. In addition, the FeTaC layer used here was formed by carrying out the spatter of the target of Fe-10at%Ta-10at%C composition in Ar atmosphere. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0053] As the example 4 1st ground layer, the magnetic-recording medium was obtained like the example 1 except having formed the FeZrN layer with a thickness of about 100nm instead of Cr layer. In addition, the FeZrN layer used here was formed by carrying out the spatter of the target of Fe-10at%Zr-10at%N composition in Ar atmosphere. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0054] The magnetic-recording medium was obtained like the example 1 except having formed the FeCo layer with a thickness of about 50nm instead of Cr layer as the example 5 1st ground layer. In addition, the FeCo layer used here was formed by carrying out the spatter of the target of Fe-50at%Co composition in Ar atmosphere. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0055] The magnetic-recording medium was obtained like the example 1 except having formed the CoZrNb layer with a thickness of about 100nm instead of Cr layer as the example 6 1st ground layer. In addition, the CoZrNb layer used here was formed by carrying out the spatter of the target of Co-5at%Zr-10at%Nb composition in Ar atmosphere. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0056] The magnetic-recording medium was obtained like the example 1 except having formed Co layer with a thickness of about 75nm instead of Cr layer as the example 7 1st ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0057] The magnetic-recording medium was obtained like the example 1 except having formed the CoCr layer with a thickness of about 40nm instead of Cr layer as the example 8 1st ground layer. In addition, the CoCr layer used here was formed by carrying out the spatter of the target of Co-33at%Cr composition in Ar atmosphere. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0058] The magnetic-recording medium was obtained like the example 1 except having formed the CoCr layer with a thickness of about 15nm instead of the ruthenium layer as a ruthenium layer with a thickness of about 20nm and the 2nd ground layer instead of Cr layer as the example 9 1st ground layer. In addition, the CoCr layer used here was formed by carrying out the spatter of the target of Co-33at%Cr composition in Ar atmosphere. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0059] The magnetic-recording medium was formed like the example 1 except not forming the example of comparison 1 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.

[0060] The magnetic-recording medium was obtained like the example 2 except not forming the example of comparison 2 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0061] The magnetic-recording medium was obtained like the example 3 except not forming the example of comparison 3 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0062] The magnetic-recording medium was obtained like the example 4 except not forming the example of comparison 4 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0063] The magnetic-recording medium was obtained like the example 5 except not forming the example of comparison 5 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0064] The magnetic-recording medium was obtained like the example 6 except not forming the example of comparison 6 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0065] The magnetic-recording medium was obtained like the example 7 except not forming the example of comparison 7 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0066] The magnetic-recording medium was obtained like the example 8 except not forming the example of comparison 8 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0067] The magnetic-recording medium was obtained like the example 9 except not forming the example of comparison 9 2nd ground layer. About the obtained magnetic-recording medium, magnetic properties were measured like the example 1. The result is shown in Table 1.
[0068]
[Table 1]
表 1

	下地層	Hc⊥(Oe)	Hc//(Oe)	Hc⊥／Hc//	垂直角型比
実施例1	Cr／Ru	3200	1230	2.60	1.00
実施例2	Fe／Ru	2820	1310	2.15	0.97
実施例3	FeTaC／Ru	3090	1350	2.29	0.99
実施例4	FeZrN／Ru	3040	1340	2.27	0.98
実施例5	FeCo／Ru	3160	1370	2.31	1.00
実施例6	CoZrNb／Ru	2650	1460	1.82	0.97
実施例7	Co／Ru	3330	1220	2.73	1.00
実施例8	CoCr／Ru	3440	1240	2.77	0.99
実施例9	Ru／CoCr	3410	1200	2.84	0.98
比較例1	Cr	1060	2900	0.37	0.15
比較例2	Fe	350	240	1.32	0.02
比較例3	FeTaC	190	200	0.95	0.01
比較例4	FeZrN	180	160	1.13	0.01
比較例5	FeCo	210	170	1.24	0.02
比較例6	CoZrNb	170	200	0.85	0.01
比較例7	Co	430	320	1.34	0.05
比較例8	CoCr	2280	1490	1.53	0.99
比較例9	Ru	2520	1670	1.51	0.85

[0069] In Table 1, it can be considered that perpendicular orientation is so good that Hc**/Hc//is large, a reproduction output is so large that a perpendicular square shape ratio is close to 1, and it is the outstanding vertical-magnetic-recording medium. Since Hc**/Hc//was one or less and the examples 1, 3, and 6 of comparison of the perpendicular square shape ratio were also small, it turns out that it is the orientation within a field. Moreover, in the examples 2, 4, and 5 of comparison, since the record layer and the soft-magnetism layer are not divided magnetically, it turns out that the measurement result is greatly influenced of the soft-magnetism layer, and serves as orientation within a field also from the small perpendicular square shape ratio as the whole medium. Although it could not say that the perpendicular

orientation of the examples 8 and 9 of comparison was enough, the best property was shown in each example of comparison.

[0070] To the magnetic properties of the above examples of comparison, since Hc**/Hc//and the perpendicular square shape ratio were large and it was also the square shape ratio 1 [about] compared with the examples 8 and 9 of comparison, as for an example 1 or 9, each was understood that the property as a vertical-magnetic-recording medium is improved. When it used independently, even if this was a ground layer with inadequate perpendicular orientation, when these are used combining the ground layer which contains a ruthenium as a principal component, it shows that it is effective in improving the crystallinity of a ruthenium. Thus, according to this invention, it turns out that Co system magnetic layer which has the outstanding perpendicular stacking tendency is obtained, and the vertical-magnetic-recording medium which has the magnetic properties of high coercive force and a high reproduction output is obtained by this.

[0071] In addition, in the above-mentioned example, although each uses the glass substrate as a nonmagnetic substrate, Si single crystal substrate to which the alloy substrate or front face of aluminum system oxidized, and the effect that it is the same even when plating of NiP etc. is further given to the front face are expected. Moreover, although only the sputtering method was taken up as a forming-membranes method, an effect with the same said of a vacuum deposition method can be acquired.

[0072] Moreover, even if a record layer contains oxygen in the artificial grid system which carried out the laminating of Pt, Co, the Pd, etc. not only to an alloy system but to Co, and these, the interface state with a ground layer is similar, and has the same effect.

[0073]

[Effect of the Invention] According to this invention, it has Co system magnetic layer with the outstanding perpendicular stacking tendency, and the magnetic-recording medium of high coercive force and a high reproduction output can be offered.

[Translation done.]

* NOTICES *

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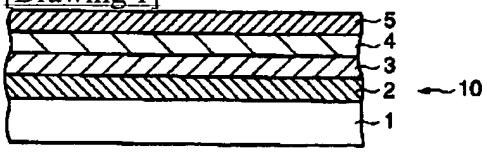
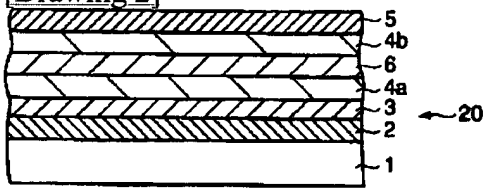
DRAWINGS

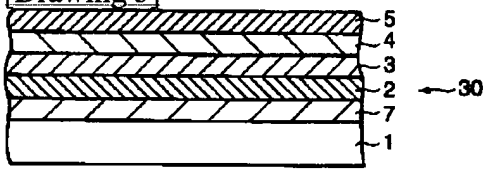
[Drawing 1]



[Drawing 2]



[Drawing 3]



[Translation done.]